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EXAMINER	
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/688,333
Filing Date: October 17, 2003
Appellant(s): COHEN, URI

Uri Cohen
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 11 March 2008 (corrected brief filed 4 April 2008) appealing from the Office action mailed 5 September 2007.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

US 5,421,987	Tzanavaras et al	6-1995
US 2002/0189637	Downes, Jr et al	12-2002
US 6,071,809	Zhao	6-2000
US 4,834,842	Langner et al	5-1989
US 5,904,827	Reynolds	5-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

1. Claims 1, 3-5 and 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Downes, Jr et al (US 2002/0189637) with evidence from Zhao (US 6,071,809, for claims 4-5 and 31-32 only).

Tzanavaras et al teach (see figure 1, abstract) a method for electrofilling a metal or alloy inside at least one opening located in a front surface of a substrate, the front surface of the substrate including at least one opening and a top field surrounding the opening, wherein the opening included a bottom and sidewalls coated with an exposed metallic surface, wherein the steps of the method included immersing the substrate in an activation solution (electrolyte), applying high pressure electrolyte jets to the substrate, wherein the electrolyte included metallic ions of the metal to be plated and applying an electroplating current to the substrate to electroplate the metal inside the opening.

Tzanavaras et al fail to teach applying ultrasonic or megasonic vibrations to the substrate prior to the onset of electroplating.

With respect to the step of applying ultrasonic or megasonic vibrations prior to agitating the electrolyte across the front surface of the substrate, it is noted that the problem being addressed by Appellant is that insufficient wetting of certain openings on the surfaces occurs when the substrate is immersed in the electrolyte.

However, that wetting problem was known, and a solution had been proposed by Downes, Jr. et al.

Downes, Jr. et al teach (see paragraphs 2-5 and 33-38) that when substrates having openings in the size range of 0.001-0.002 inches (25.4-50.8 microns) were immersed in a liquid, there were problems with adequate wetting within the openings. Downes, Jr. et al teach that in order to avoid the problem of entrained air in the openings, ultrasonic or megasonic vibrations were applied to the substrate to dislodge any air within the openings to ensure proper wetting of the openings in the surface of the substrate.

Therefore, since the prior art recognized both the wetting problem associated with immersing substrates having openings surrounded by a field on a front surface of a substrate and the solution of using ultrasonic or megasonic vibrations to ensure adequate wetting of the interiors of the openings, it would have been obvious to one of ordinary skill in the art to have applied, prior to commencement of electroplating in the process of Tzanavaras et al, ultrasonic or megasonic vibrations to the substrate of Tzanavaras et al for the known purposes of ensuring adequate wetting of openings in the surface of the substrate in the size range of 25.4-50.8 microns.

Since the application of the ultrasonic or megasonic vibrations were needed when the substrate was immersed in the electrolyte, it would have been obvious to one of ordinary skill in the art to have applied the vibrations within the electroplating chamber.

Regarding claim 29, the act of applying the high pressure jets in Tzanavaras et al established turbulent flow of the electrolyte at the surface of the substrate.

Regarding claims 3 and 30, Tzanavaras et al teach (see col. 1, lines 7-13) that the process was applicable to electroplating through patterned masks (i.e.-where the bottom of the opening was metal and the sidewalls were non-metallic.

Regarding claims 4-5 and 31-32, in addition to the electroplating through a mask design discussed by Tzanavaras et al, conventional electroplating of microelectronic substrates includes forming openings, depositing a metal seed layer on the bottom and sidewalls of the opening, followed by electroplating of metal. Such steps are shown to be known and conventional in Zhao (US 6,071,809) in figures 3H-3K and cols. 6-7. Thus, it would have been within the routine skill in the art of electroplating to have utilized the conventional substrates of Zhao within the electroplating process of Tzanavaras et al.

2. Claims 2, 7-9, 34-37 and 39-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Downes, Jr. et al (US 2002/0189637) as applied to claims 1 and 29 above, and further in view of Langner et al (US 4,834,842) with evidence from Zhao (US 6,071,809, for claims 8-9, 36-37 and 41-42 only).

The teachings of Tzanavaras et al and Downes, Jr et al. are described above.

Neither of these references expressly teach that the electrolyte plating bath included an inhibitor additive.

Langner et al (see abstract and col. 1, lines 18-34) a conventional additive for copper electroplating baths included inhibitors. The inhibitors were added to ensure a uniform deposit.

Therefore, it would have been obvious to one of ordinary skill in the art to have added an inhibitor as taught by Langner et al to the electrolyte of Tzanavaras et al because the inhibitor increased uniformity of the electroplated metal.

Regarding claim 39, as above, the combination of Tzanavaras et al with Downes, Jr. et al teaches one of ordinary skill in the art to perform the wetting of the substrate within a single cell by immersing the substrate in an electrolyte and applying ultrasonic or megasonic vibrations.

Regarding claims 7, 35 and 40, Tzanavaras et al teach (see col. 1, lines 7-13) that the process was applicable to electroplating through patterned masks (i.e.-where the bottom of the opening was metal and the sidewalls were non-metallic.

Regarding claims 8-9, 36-37 and 41-42, in addition to the electroplating through a mask design discussed by Tzanavaras et al, conventional electroplating of microelectronic substrates includes forming openings, depositing a metal seed layer on the bottom and sidewalls of the opening, followed by electroplating of metal. Such steps are shown to be known and conventional in Zhao (US 6,071,809) in figures 3H-3K and cols. 6-7. Thus, it would have been within the routine skill in the art of electroplating

to have utilized the conventional substrates of Zhao within the electroplating process of Tzanavaras et al.

3. Claims 6 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Downes, Jr. et al (US 2002/0189637) as applied to claims 1 and 29 above, and further in view of Reynolds (US 5,904,827).

Tzanavaras et al and Downes, Jr. et al fail to teach applying the ultrasonic vibrations during the electroplating treatment.

Reynolds teaches (see abstract, figure 3 and related description) including a megasonic transducer (90-92) for agitating the electrolyte in a copper electroplating process.

Therefore, it would have been obvious to one of ordinary skill in the art to have continued applying the ultrasonic vibrations to the substrate and electrolyte as taught by Reynolds to the method of Tzanavaras et al and Downes, Jr. et al because the ultrasonic vibrations would have increased uniformity of the electroplating (see Reynolds at col. 8, lines 45-56).

4. Claims 10 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Downes, Jr. et al (US 2002/0189637) and Langner et al (US 4,834,842) as applied to claims 2 and 34 above, and further in view of Reynolds (US 5,904,827).

Tzanavaras et al and Downes, Jr. et al fail to teach applying the ultrasonic vibrations during the electroplating treatment.

Reynolds teaches (see abstract, figure 3 and related description) including a megasonic transducer (90-92) for agitating the electrolyte in a copper electroplating process.

Therefore, it would have been obvious to one of ordinary skill in the art to have continued applying the ultrasonic vibrations to the substrate and electrolyte as taught by Reynolds to the method of Tzanavaras et al and Downes, Jr. et al because the ultrasonic vibrations would have increased uniformity of the electroplating (see Reynolds at col. 8, lines 45-56).

5. Claim 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Downes, Jr. et al (US 2002/0189637) and Langner et al (US 4,834,842) as applied to claims 39-42 above, and further in view of Reynolds (US 5,904,827).

Tzanavaras et al and Downes, Jr. et al fail to teach applying the ultrasonic vibrations during the electroplating treatment.

Reynolds teaches (see abstract, figure 3 and related description) including a megasonic transducer (90-92) for agitating the electrolyte in a copper electroplating process.

Therefore, it would have been obvious to one of ordinary skill in the art to have continued applying the ultrasonic vibrations to the substrate and electrolyte as taught by

Reynolds to the method of Tzanavaras et al and Downes, Jr. et al because the ultrasonic vibrations would have increased uniformity of the electroplating (see Reynolds at col. 8, lines 45-56).

(10) Response to Argument

Appellant has argued the following points.

(a) Tzanavaras et al teach away from the need to add additional method steps to ensure adequate wetting at col. 3, lines 13-22.

In response, the teachings of Tzanavaras et al at col. 3, lines 13-22 are noted by the examiner, but such passage does not constitute an actual "teaching away". A proper "teaching away" is a statement within a prior art reference that specifically states that doing "A" is not desirable or would lead to bad results. This is clearly not the case when it comes to the passage of Tzanavaras et al. Tzanavaras et al merely state that sufficient agitation is achieved, and does not teach against applying any other solution to help aid in agitation or wetting.

(b) Downes, Jr et al teach away from the claimed invention by teaching that the wetting step occurs in a different composition and chamber than a subsequent coating step.

In response, as above, a teaching of a preference by a prior art reference should not be construed as a teaching away from the alternatives by the reference. Further, with respect to this feature, the wetting of the substrate in Tzanavaras et al is done in the electrolyte, with the electroplating chamber. The wetting of Downes, Jr et al occurs

(see paragraph 33) that the disclosed arrangement (figure 1) is exemplary of a system to ensure wetting prior to a subsequent wet chemical process. Downes, Jr et al never state that the wetting liquid cannot be the same liquid as is used in the subsequent wet chemical process.

(c) The present invention relies on unexpected results shown in the declaration under 37 CFR 1.132 that it is “wide” trenches and vias that have problems with wetting, as opposed to the “narrow” trenches and vias taught by Downes, Jr et al.

In response, first, the data provided is not commensurate in scope with the claims. Or more accurately, the claims do not provide any range of sizes of openings on the substrate, and the data indicates that only specific sizes of openings have the described wetting problems. Second, the absolute width size of the features described by Appellant in the 132 declaration which had problems were 17 microns and 55 microns (see Table 1). The “narrow” features described by Downes, Jr et al have width sizes in the range of 0.001-0.002 inches which equals about 25-50 microns. Therefore, there is complete expectation by one of ordinary skill in the art of the wetting problem with the size of features described by Appellant in the 132 declaration. Further, Appellant points to paragraphs 24 and 42 of Downes, Jr et al as indicating that Downes, Jr et al show that ultrasonic vibration was not necessary for prewetting holes or vias having low aspect ratios. The important word here is that Downes, Jr et al say that they "may" not be necessary. That would indicate to one of ordinary skill in the art that inducing ultrasonic vibration would be one way to ensure adequate wetting, even if it wasn’t strictly necessary.

Appellant's remarks regarding Issues 2-4 appear to be cumulative in effect, and merely state that the additional references relied upon by the examiner do not cure the deficiencies of the combination of Tzanavaras et al and Downes, Jr et al.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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